

TAXONOMY OF *ARACHNIS*, *ARMODORUM*, *ESMERALDA*,  
AND *DIMORPHORCHIS* (ORCHIDACEAE)<sup>1</sup>  
PART II

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MORPHOLOGY

The delimitation of *Arachnis* and two closely allied genera, *Vandopsis* and *Renanthera*, has elicited differences of opinion. Holttum (1947, 1957) tried to resolve the taxonomic problems involving these three genera, and conducted a comparative survey of *Vandopsis*, *Renanthera* and *Arachnis*. Essentially, these three genera can be distinguished by the structure of the labellum and its relation to the column.

Pfitzer (1889) based his description of *Vandopsis* on *V. gigantea* (Lindl.) Pfitz. and *V. lissochiloides* (Gaud.) Pfitz. (Figure 1). These two species had been included by Bentham in *Stauroopsis*, a name proposed by Reichenbach in 1860. *Vandopsis* flowers are usually fleshy. The labellum is firmly attached to the base of the column by reduced side lobes. The sac that develops at the base of the mid lobe is obscure, and in *V. lissochiloides*, a fleshy callus stretches over the base of the mid lobe. The column of *Vandopsis* is usually shorter than that of *Renanthera* and *Arachnis*.

The description of the genus *Renanthera* by Loureiro in 1790 is based on the type species *R. coccinea* (Figure 2). The characteristic *Renanthera* flower is bright red, but occasionally yellow flowers with red markings occur. The petals and dorsal sepal are narrow and outspread, while the lateral sepals are enlarged and close to each other. The labellum is not fleshy as in *Vandopsis* or *Arachnis*, and is attached to the base of the column so that it is only slightly movable. A spur is present, and the mid lobe curves down in front of the spur. At the throat of the spur are two prominent calli. The leaves and habit of the plants resemble closely those of *Arachnis*.

The greatest amount of taxonomic confusion has derived from the species that have been placed in the genus *Arachnis*. To retain all these species within *Arachnis*, it would be necessary to redefine the generic concept. At least four distinct groups can be recognized among the species. Each of these groups is as distinct from the others as *Vandopsis* is from *Renanthera*. Holttum recognized five groups, and Hawkes proposed five sectional names for them in 1952. As mentioned earlier, these names are invalid according to nomenclatural rules. However, four valid generic names already exist, and the groups are certainly distinct enough from each other to warrant retaining these names. The sixteen species and the natural hybrid in question should be classified accordingly:

*Arachnis*:

- A. flos-aeris* (L.) Rchb.f. (type species)
- A. annamensis* (Rolfe) J. J. Sm.
- A. hookeriana* (Rchb.f.) Rchb.f.
- A. limax* Seidenf.
- A. Xmaingayi* (Hook.f.) Schltr. (pro. sp.)
- A. breviscapa* (J. J. Sm.) J. J. Sm.

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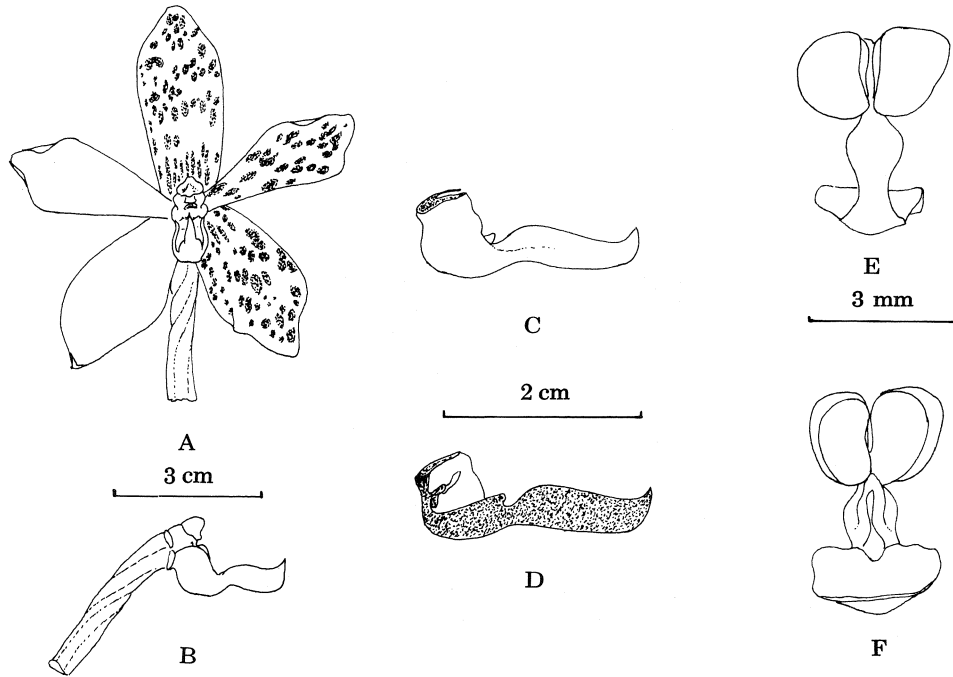


Figure 1. *Vandopsis lissochiloides*: A, flower; B, side view of flower with petals and sepals removed; C, labellum; D, sagittal section through labellum; E, pollinia, external view; F, pollinia, internal view.

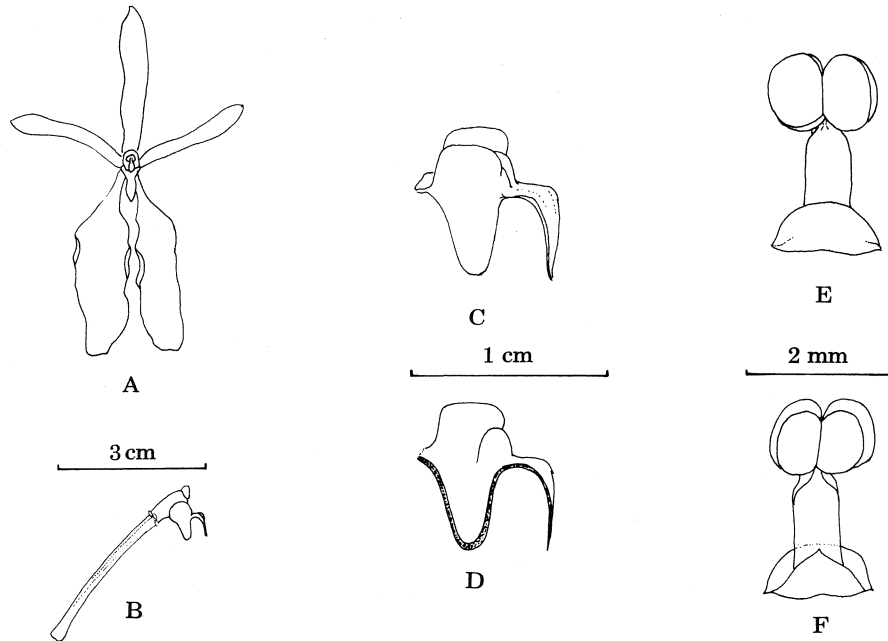


Figure 2. *Renanthera coccinea*: A, flower; B, side view of flower with petals and sepals removed; C, labellum; D, sagittal section through labellum; E, pollinia, external view; F, pollinia, internal view.

- A. celebica* (Rolfe) J. J. Sm.
- A. longicaulis* (Schltr.) L. O. Wms.
- A. lyonii* Ames
- A. beccarii* Rchb.f.
- A. labrosa* (Lindl. et Paxt.) Rchb.f.
- A. calcarata* Holtt.

#### *Armadorum*

- A. sulingi* (Bl.) Schltr. (type species)
- A. siamense* Schltr.

#### *Esmeralda*

- E. cathcartii* (Lindl.) Rchb.f. (type species)
- E. clarkei* Rchb.f.

#### *Dimorphorchis*

- D. lowii* (Lindl.) Rolfe (type species)

All four genera possess versatile labella, but *Arachnis* is distinguished from *Esmeralda* and *Armadorum* by the details of the labella, and from *Dimorphorchis* by the dimorphism exhibited by the flowers of the latter genus.

Blume's genus *Arachnis* as typified by *A. flos-aeris* consists of eleven species and one natural hybrid that appear to fall into four sections. The plants, with the exception of *A. beccarii*, have elongated stems and a scrambling habit, usually starting terrestrially and climbing up the nearest support. The stiffly erect to arching or semipendant inflorescences bear flowers with clawed petals and sepals. The mid lobe of the versatile labellum is attached at an angle where the side lobes meet, and in the angle is a commonly obscure sac. The typical group consisting of *A. flos-aeris*, *A. hookeriana*, *A. Xmaingayi*, *A. annamensis* and *A. limax* produce inflorescences that are erect to arching, branched or unbranched, and range from 50 to 160 centimeters long. This last trait easily distinguishes this group from the group of *A. breviscapa*. Also, the flowers of the former group have the scorpion-like appearance suggested by the name of the genus. The four species in the *A. breviscapa* group (*A. breviscapa*, *A. celebica*, *A. longicaulis*, and *A. lyonii*) possess short inflorescences with three to five flowers. The flowers have broader sepals and petals than those of the typical group, and the edges of the sepals and petals are undulate. The plants are lithophytic and epiphytic, climbing over broken limestone slopes and up nearby trees and shrubs. The four species listed in this group are very similar to each other, the major point of distinction being their ranges of distribution. Further collecting and study may show all four species to be mere geographical variants of *A. breviscapa*.

The third group in *Arachnis* consists of a singular species from New Guinea, *A. beccarii* (the valid earlier name of *A. muelleri*). This species is readily distinguished by its shortened stem, long coriaceous foliage, and a tall, branched, woody-like inflorescence which continues to produce flowers for several years. This insular species produces flowers that belong unmistakably in *Arachnis*, but the growth habit has diverged so greatly from the norm in the genus that it has often been mistaken for a species of *Vandopsis*.

The last group of *Arachnis* consists of two species, *A. labrosa* and *A. calcarata*. The flowers of *A. calcarata* are about twice the size of those of *A. labrosa*, but careful examination reveals a close affinity between the two.

Vegetatively, the linearly rectangular leaves of these two species are longer and narrower than those of the typical group. The labella are distinctly spurred, and the spurs are posteriorly directed. At the base of the mid lobes of the labella of both species are bi-lobed calli which nearly conceal the throats of the spurs. *Arachnis labrosa* has been placed in a genus of its own, *Arrhynchium* Lindl., but it is best included in the genus *Arachnis* next to *A. calcarata*.

Two species are included in *Armadorum* (*A. sulingi* and *A. siamense*). The type species, *A. sulingi*, had been recognized by Blume, the author of *Arachnis*, as not belonging in *Arachnis*, but in a different genus. Blume placed it first in *Aerides*, and later moved it to *Vanda*. Lindley, who reduced *Arachnis* to a synonym of *Renanthera*, first included Blume's *Aerides sulingi* in *Renanthera*, and later moved it to *Vanda*. The concept of the genus, however, had been recognized earlier by Van Breda (1827) who proposed the name *Armadorum*. The name of the type species, *Armadorum distichum*, is a synonym of Blume's *Aerides sulingi*. Hence, the correct name of the type species of *Armadorum* is *A. sulingi*. *Armadorum* proved to be a controversial genus, with Smith and Holttum favoring its reduction as a synonym of *Arachnis*, and Schlechter maintaining it as a distinct genus. The fact that these two species do not fit comfortably into any previous genus has been demonstrated by the frequent transfers made by early taxonomists. Moreover, the two species are readily distinguished by the presence of a distinct, anteriorly directed spur over which curves a dorso-ventrally compressed, downward pointing, ovoid and fleshy mid lobe.

The genus *Esmeralda* consists of two species that occur primarily on the Asian continent. Reichenbach based the description of this genus on Lindley's *Vanda cathcartii* in 1874. Since then, the genus has been reduced into synonymy of *Arachnis* by Bentham and Hooker, reinstated by Schlechter, and reduced again by Smith and Holttum. However, a careful consideration of all the species that have been lumped in *Arachnis* will show that *Esmeralda* is a sound genus. It shares a similar growth habit with *Arachnis*, but is readily distinguished from *Arachnis* and the other allied genera by its very lightly pendulous labellum with its concealed hollow tube or nectary. A slight breeze sends the labellum into motion.

*Dimorphorchis* is a monotypic genus that is apparently endemic to Borneo. The type species was originally described by Lindley as *Vanda lowii* before coming to uneasy rest in the genus *Arachnis*. Rolfe finally placed it in its own genus *Dimorphorchis* in 1919. *Dimorphorchis lowii* and its variety *rohaniana* (Rchb.f.) Tan<sup>2</sup> can be readily separated from the foregoing genera by the limp, tomentose inflorescences, by the presence of dimorphic flowers (of different form and color) on these inflorescences, and by its strictly epiphytic habit as opposed to the usually scandent mode of growth displayed by the other genera.

#### KEY TO THE GENERA

1. Labellum firmly attached to the column ..... *Vandopsis-Renanthera*  
Alliance
- 1a. Labellum versatile
  2. Flowers of one type on the same inflorescence
  3. Nectary not concealed in the mid-lobe of the labellum

<sup>2</sup>DIMORPHORCHIS LOWII (Lindl.) Rolfe var. rohaniana (Rchb.f.) Tan, comb. nov. *Renanthera rohaniana* Rchb.f., *Xenia Orchid.* 1: 89. 1858.

4. Mid-lobe of the labellum laterally compressed ..... *Arachnis*  
 4a. Mid-lobe of the labellum dorsally compressed .... *Armodorum*  
 3a. Nectary concealed in the mid-lobe of the labellum .... *Esmeralda*  
 2a. Flowers dimorphic ..... *Dimorphorchis*

#### PHYTOGEOGRAPHY

The distribution of the *Arachnis* complex extends from longitude 85°E to 160°E and between latitudes 28°N and 80°S. This area includes all insular southeast Asia, bordered by the Asian continent to the northwest and Australia to the south-southeast (Figure a). Of the four genera concerned, *Arachnis* has the widest range, with its center of distribution in Malaysia (Figure b, c). Geographically, this includes the whole of Indonesia, the Malay Peninsula, Christmas Island (Indian Ocean), the islands of Borneo, Timor, the Philippines, New Guinea, the Bismark Archipelago and the Solomon Islands.

Malaysia is a distinct phytogeographical unit (van Steenis, 1950) with contacts with the adjacent floristic region of Asia in the Malay Peninsula and the Philippine Islands, with the Pacific Islands flora in the Bismarck Archipelago and Solomon Islands, and with the Australian flora in the island of New Guinea. The high percentage of genera entirely confined to Malaysia as compiled in the first volume of *Flora Malesiana* (van Steenis, 1950) strongly supports the consideration of the region as a distinct floristic unit.

Within the Malaysian floristic region, subdivisions have been drawn, based on climatic, edaphic, geological, and topographic factors. The distribution of the species of *Arachnis* and related genera support some of these floristic demarcations. Two species and a natural hybrid, *A. flos-aeris*, *A. hookeriana* and *A. Xmaingayi* are distributed primarily within west Malaysia (Figure c). The two species and the hybrid are found on the Malay Peninsula, and *A. hookeriana* extends into Indochina. They also occur in Singapore and its surrounding islands, and on the island of Borneo. The fact that *A. Xmaingayi* is found only where the ranges of *A. flos-aeris* and *A. hookeriana* overlap suggests its hybrid origin. *A. flos-aeris* has the broadest range of the three, extending into Sumatra to the west, Java to the south, Bali to the southeast, and the Philippine island of Tawitawi to the northeast. Thus, the distribution of *A. flos-aeris* parallels Huxley's "Wallace Line" to the southeast, and its northern continuation along the west side of the Philippines between Palawan and Mindoro as projected by Merrill and Dickerson (van Steenis, 1950).

The habits and habitats of the two species are very similar. The plants usually begin terrestrially, eventually scrambling up on neighboring shrubs and trees. They grow along sandy or alluvial coastal areas, quite often together. In these areas, trade winds bring abundant rain, often above 250 cm per annum, and temperatures remain uniformly high with a mean of about 80°F. Growth is rapid under such conditions. *Arachnis hookeriana* appears to be restricted to these low-lying coastal areas. *Arachnis flos-aeris* has been found climbing trees along riverbanks, and at elevations of over 1000 meters on limestone hills where they are found upon trees over thirty meters tall. *Arachnis Xmaingayi* is a fertile hybrid which back-crosses with both parents. It has a wider range of habitat than *A. hookeriana*, occurring at elevations of over 4000 meters on Mount Kinabalu in Borneo.

Little is written about the habitat of *A. annamensis*, but it flowers in cultivation on a much shorter stem than *A. flos-aeris*, producing unbranched inflorescences. Herbarium specimens of long, branching panicles suggest that this species also reaches a sufficient height to produce inflorescences similar to the long, semi-pendant ones found in *A. flos-aeris*. *Arachnis annamensis* has not been found growing naturally outside Indochina. *Arachnis limax* is reported to be endemic in Thailand (Seidenfaden, 1970).

The *A. breviscapa* complex of four species occurs chiefly in West Malaysia, overlapping in range with the East Malaysian species of *A. flos-aeris*, *A. hookeriana* and the hybrid *A. Xmaingayi* only on the island of Borneo, and extending eastward to the Solomon Islands. The four species in the complex, *A. breviscapa*, *A. celebica*, *A. longicaulis* and *A. lyonii* are so similar that they are probably geographical variants of *A. breviscapa*. *Arachnis breviscapa* occurs on the island of New Guinea, and *A. lyonii* in the Philippines. The plants are lithophytic, scrambling over limestone rock outcrops and cliffs. The elevation of these habitats is usually about a hundred meters above sea level, well drained, and unshaded except by competing shrubbery. Branching is frequent near the base of the plants, and during the flowering season in late September and early October, several short spikes are produced along each stem.

Of the twelve species of *Arachnis*, *A. beccarii* has the most distinctive growth habit. It is found near the eastern limit of the Malaysian floristic region, occurring on New Guinea and some immediate islands. *Arachnis beccarii* was first described by Reichenbach in 1886, but nothing was written regarding its habitat. In 1894, Kränzlin, who described the same species as *Vanda muelleri*, included the information that it was growing on big rocks. Describing it later as *Stauroopsis imthurnii*, Rolfe (1917) noted that the plant was found on a fallen trunk along with other orchids, ferns and grasses. The most recent report of the rediscovery of this species was made by Millar (1973) who described it growing on rocks in exposed, rough terrain. This striking species bears leathery leaves that reach three meters in length, and produce wood-like, branching inflorescences that tower above three meters. These inflorescences develop for more than a year, producing flowers at different periods. Flowers have been collected during the summer, fall and winter months. Millar also noted that as the stem grows upward, increasing in size, "the base of the plant elongates in the other direction," producing new shoots. The plants collected in New Guinea produce brown-barred yellow flowers with lips marked with purple. The specimens from Misool and the Solomon Islands apparently produce white flowers with purple-marked lips.

*Arachnis calcarata* has been collected from only a single locality, Mount Poe (Rumput) in Sarawak on the island of Borneo. According to Holttum, the plants probably grew in open places on the upper part of the mountain at 1000 to 3000 meters in elevation. They have been found in flower from May through August.

*Arachnis labrosa* occurs in the Khasi Hills of Assam where rainfall is extremely heavy. It has also been collected along the Kwantung-Tonkin border and on the island of Hainan. Although primarily epiphytic, *A. labrosa* has also been found growing among scattered shrubs in dry, clayey soil.

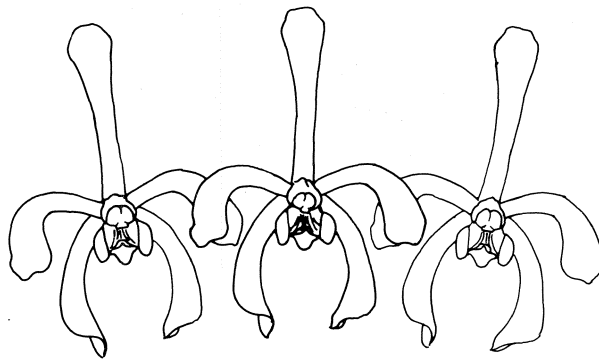
The two species of *Armadorum* usually grow at elevations of from 300 to 2000 meters above sea level. *Armadorum sulingi* has a broader and more southern range (Figure d), from Sumatra, through Java to Bali, and grows at lower altitudes. The plant habit with its short stem is closer to that of *Vanda* than to *Arachnis*. Moreover, it has been found growing only epiphytically.

*Armadorum siamense* has been collected only in the highlands of northern Thailand. Like *A. sulingi*, it grows epiphytically in the evergreen forests at about 2000 meters in elevation. The stems branch very sparingly.

The genus *Esmeralda* is largely confined to the Asian continent (Figure b). The ranges of the two species, *E. cathcartii* and *E. clarkei* overlap in the eastern Himalayas, where they are found at elevations of from 1000 to 3000 meters (Figure d). *Esmeralda clarkei* has the broader range of the two species, extending into Burma and Thailand to the south, and the island of Hainan to the east. Hooker (1870) reported that *E. cathcartii* favored shady, hot and humid habitats, while *E. clarkei* had been found growing epiphytically in the west evergreen forests of Burma and northern Thailand. The growth habit of the genus resembles that of *Arachnis*, and the plants ascend the nearest support to swing pendulously in the air. This mode of growth affords maximum advantage for the peculiar hinged labella which oscillate with the slightest breeze.

Like *Arachnis calcarata*, the monotypic genus *Dimorphorchis* also appears to be restricted to the island of Borneo. *Dimorphorchis lowii* is usually found in hot and humid low-lying areas such as along riverbanks. A single plant often produces numerous stems to form a large clump in the crown of a high tree. The leaves are long and coriaceous, and the stems are stout. During the flowering season from late summer to fall, many long, hairy inflorescences hang limply pendant from the cluster of stems. These inflorescences reach four meters or more in length, bearing the characteristic dimorphic blooms. This unusual trait of having the first two to four flowers on the inflorescence lemon yellow, and the rest deep maroon, is probably concerned with the pollination ecology of the species. Information regarding this phenomenon is still lacking.

A map of the areas where field work was conducted follows (Figure a), as well as distribution maps of *Arachnis*, *Armadorum*, *Dimorphorchis* and *Esmeralda* (Figure b) and of the individual species of the four genera (Figure c, d).



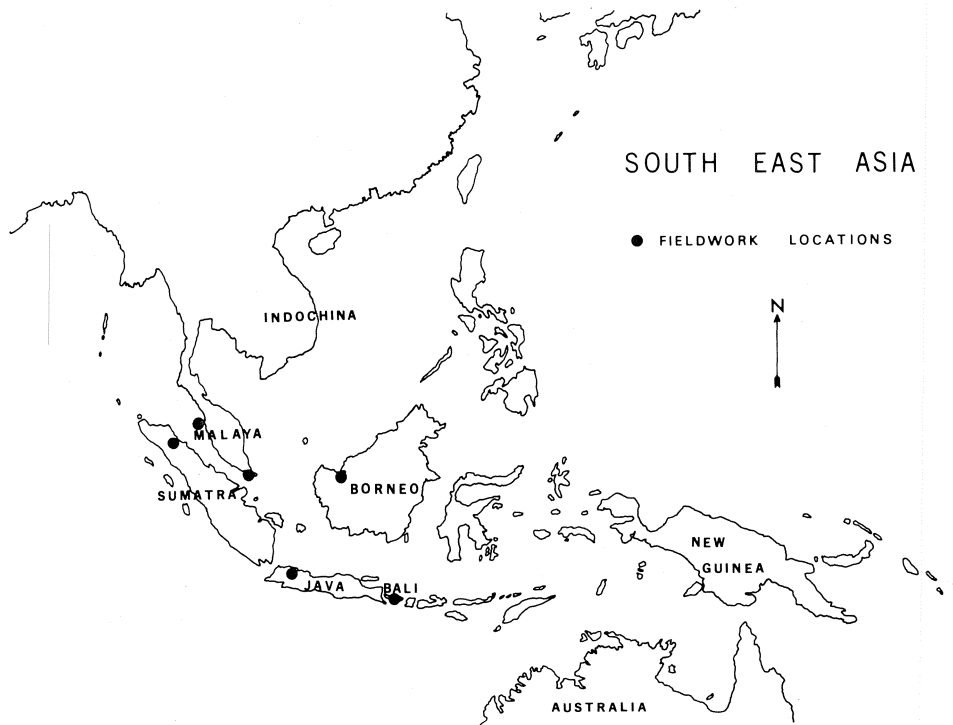


Figure a. Map of locations of field work in South East Asia.



Figure b. Distribution map of *Arachnis*, *Armodorum*, *Dimorphorchis* and *Esmeralda*.





Figure c. Distribution map of species of *Arachnis*.

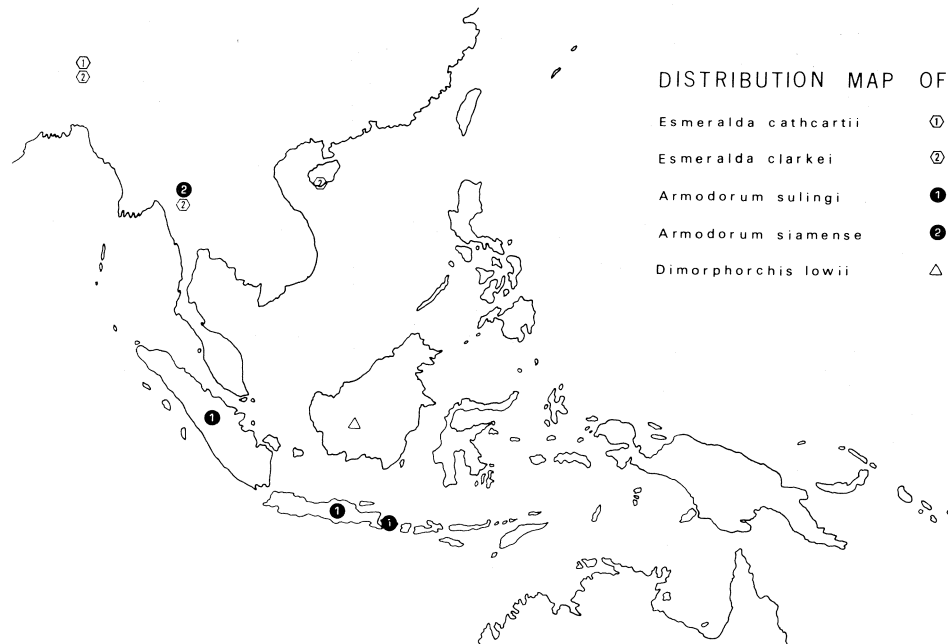


Figure d. Distribution map of species of *Armodorum*, *Dimorphorchis* and *Esmeralda*.